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27JUL00 E556004-1 D02855
P01/7700 0.00-0018319.4 The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference — 3/20/P32444GB

2. Patent application number *(The Patent Office will fill in this part)* — 0018319.4 — 27 JUL 2000

3. Full name, address and postcode of the or of each applicant *(underline all surnames)* — IMAGING AND SENSING TECHNOLOGY CORPORATION
300 ISTC Center
Horseheads
New York 14845
United States of America

Patents ADP number *(if you know it)* — 7584337002

If the applicant is a corporate body, give the country/state of its incorporation — NEW YORK, UNITED STATES OF AMERICA

4. Title of the invention — FLUID-POWERED INSPECTION CAMERA

5. Name of your agent *(if you have one)* — MATHISEN, MACARA & CO

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)* — The Coach House
6-8 Swakeleys Road
Ickenham
Uxbridge UB10 8BZ

Patents ADP number *(if you know it)* — 1073001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

c) any named applicant is a corporate body.

See note (d)) — YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	11
Claim(s)	3
Abstract	1
Drawing(s)	5+5

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature MATHISEN, MACARA & CO — Date 26/7/00 (26 JULY 2000)

12. Name and daytime telephone number of person to contact in the United Kingdom: M.E. GOODANEW 01895 678331

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After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

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Patents Form 7/77

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7/77

Statement of inventorship and of right to grant of a patent

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference	3/P32444GB
2. Patent application number *(if you know it)*	0018319.4
3. Full name of the or of each applicant	IMAGING AND SENSING TECHNOLOGY CORPORATION
4. Title of the invention	FLUID-POWERED INSPECTION CAMERA
5. State how the applicant(s) derived the right from the inventor(s) to be granted a patent	BY VIRTUE OF THE INVENTOR'S EMPLOYMENT BY IMAGING AND SENSING TECHNOLOGY LIMITED AND AN ASSIGNMENT DATED 31ST JANUARY 2001 BETWEEN IMAGING AND SENSING TECHNOLOGY LIMITED AND ITS US PARENT COMPANY, IMAGING AND SENSING TECHNOLOGY CORPORATION
6. How many, if any, additional Patents Forms 7/77 are attached to this form? *(see note (c))*	
7.	I/We believe that the person(s) named over the page *(and on any extra copies of this form)* is/are the inventor(s) of the invention which the above patent application relates to. Signature *Mathisen Macara* Date MATHISEN, MACARA & CO. (Agents for the Applicant) 24/05/01
8. Name and daytime telephone number of person to contact in the United Kingdom	M.E. GOODANEW 01895-678331

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Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

WOODSTOCK Peter

7 Wellington Road
Hampton Hill
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8153512001

Patents ADP number *(if you know it)*:

Patents ADP number *(if you know it)*:

Patents ADP number *(if you know it)*:

Reminder

Have you signed the form?

FLUID-POWERED INSPECTION CAMERA

The present invention relates generally to the field of inspection cameras, and more particularly, to an improved fluid-powered inspection camera that is adapted for use in environments where electrical power is not readily available.

Inspection and surveillance cameras are in widespread use today. These are sometimes used in or around hazardous and/or contaminated environments, such as to monitor and view the ignition and/or combustion of a furnace. As used herein, a "contaminated" environment typically contains airborne dust or particulate material that obscures a normal view of an object to be seen. In some applications, notably steel mills, a source of electrical power may not be readily available at the site of the furnace, or it may not be desirable to have unnecessary power cables in such environment. However, compressed air is generally available at various locations near the furnace.

Hence, it would be generally desirable to provide an improved inspection camera for such applications that can be powered by a locally-available source of compressed air or other fluid.

According to the invention there is provided a fluid-powered inspection device adapted to be operated in a contaminated environment, comprising a body having a

tubular shell terminating in an open end, an imaging device having a portion arranged within said tubular shell in spaced relation thereto so as to define an annular chamber therebetween, said imaging device having an eye positioned adjacent said open end, a fluid-powered motor arranged within said body, said motor having a fluid inlet adapted to be connected to a suitable source of compressed fluid and having a fluid outlet, a generator arranged within said body and operatively coupled to said motor, said generator being arranged to supply electrical power to said imaging device as a function of the fluid flow passing through said motor, and wherein the fluid discharged from said motor outlet passes through said annular chamber and is discharged through said open end, whereby the fluid supplied to said motor powers and cools said imaging device and keeps clean said eye.

The fluid is preferably compressed air. However, the device may utilize other fluids, such as nitrogen, etc. The inspection device may be a video camera, a television camera, an infrared camera, or some other type of camera or device. The eye may include a lens, and the flow of fluid discharged from the tube open end is directed so as to cool the eye, and to protect the eye from contaminants in the environment. In the preferred embodiment, the device further includes an eductor, which is operatively arranged such that fluid discharged from the motor outlet passes through the eductor and entrains ambient air from within the chamber into the flow discharged through the tube open end. Preferably, compressed air supplied from the source is combined with air discharged from the motor outlet upstream of the eductor. The flow of compressed

air is arranged to cool the imaging device, as well as the eye.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a top plan view of a preferred form of the fluid-powered inspection device, in accordance with the invention but with the external electrical connection and compressed fluid supply line removed;

Fig. 2 is a front elevation of the inspection device shown in Fig. 1;

Fig. 3 is a view, partly in vertical cross-section and partly in elevation, of the inspection device, this view being taken generally on line 3-3 of Fig. 1;

Fig. 4 is a view, partly in vertical cross-section and partly in elevation of the device, this view taken generally on line 4-4 of Fig. 2;

Fig. 5 is an enlarged view of the structure shown in Fig. 4, but showing the major subassemblies thereof in exploded aligned relation to one another;

Fig. 6 is an enlarged view of the structure shown in Fig. 3, but showing the major subassemblies thereof in exploded aligned relation to one another;

Fig. 7 is a fragmentary transverse vertical sectional view taken generally on line 7-7 of Fig. 2;

Fig. 8 is a fragmentary transverse vertical sectional view taken generally on line 8-8 of Fig. 2;

Fig. 9 is a right end elevation of the body shown in Fig. 5; and,

Fig. 10 is a fragmentary transverse vertical sectional view taken generally on line 10-10 of Fig. 5.

At the outset, it should be clearly understood that like reference numerals are intended to identify the same structural elements, portions or surfaces, consistently throughout the several drawing figures, as such elements, portions or surfaces may be further described or explained by the entire written specification, of which this detailed description is an integral part. Unless otherwise indicated, the drawings are intended to be read (e.g., cross-hatching, arrangements of parts, proportion, degree, etc.) together with the specification, and are to be considered a portion of the entire written description of this invention. As used in the following description, the terms "horizontal", "vertical", "left", "right", "up" and "down", as well as adjectival and adverbial derivatives thereof (e.g., "horizontally", "rightwardly", "upwardly", etc.), simply refer to the orientation of the illustrated structure as the particular drawing

figure faces the reader. Similarly, the terms "inwardly" and "outwardly" generally refer to the orientation of a surface relative to its axis of elongation, or axis of rotation, as appropriate.

Referring now to the drawings, and, more particularly, to Figs. 1-6 thereof, a fluid-powered inspection device 20 in accordance with the invention is shown as being formed of three major subassemblies. A leftward subassembly is indicated at 21, a middle or intermediate subassembly is indicated at 22, and a rightward subassembly is indicated at 23. These three subassemblies, when connected together, form the assembled body.

The device is adapted to be connected to a suitable source (not shown) of pressurized fluid, such as compressed air. Such pressurized fluid is adapted to be supplied from a suitable source (not shown) via a conduit (not shown) to an inlet fitting 24. This inlet fitting then communicates the supplied fluid: (a) with a pair of lateral eductors, several indicated at 25, (b) with a passageway establishing a primary cooling flow through leftward subassembly 21, as described *infra*, (c) with another passageway communicating the supplied fluid with an air motor, as described *infra*, and (d) with a positive pressure source for right subassembly 23. In Figs. 1 and 2, the leftward subassembly 21 generally houses an optical lens, intermediate section 22 generally houses the flow controller, and rightward section subassembly 23 generally houses the video signal processor, which is then transmitted from the camera via electrical

connector 26 at the right end of the assembled device.

Referring now to Figs. 5 and 6, the leftward subassembly 21 is shown as broadly including a horizontally-elongated thin-walled cylindrical outer tube 28, and a horizontally-elongated thin-walled cylindrical inner tube 29. These two tubes define a horizontally-elongated chamber 30 therebetween having an annular transverse cross-section. A lens assembly, generally indicated at 31, is mounted on the open left end of inner tube 29, and is positioned adjacent the open left end of outer tube 21. An objective tube, generally indicated at 32, in the form of a horizontally-elongated cylindrical rod, is arranged within the inner tube and is arranged to transmit the visual image sensed by lens 31 to the electronics contained in the other portions of the device. As will be described herein, compressed fluid is arranged to flow from right to left through chamber 30 and the annular chamber defined by the spaced relation between tube 32 and the inner wall of tube 29 to cool the optical components contained within inner tube 29, and to flush contaminants from lens 31, and to generally discharge fluid through the leftward open end 27 of the outer tube so as to permit the lens to view a suitable object to the left of the assembly. The compressed fluid supplied to the front of the inner tube, which contains the forward section of relay lens 33, is isolated from the dirty ambient air until such time as it is discharged from the assembly. The compressed fluid in this stream is intended to be clean, of high velocity, and of low volume. The philosophy behind this is that the consumption of clean compressed fluid is minimized by allowing the entrained dirty air to perform

as much of the cooling as possible, and this entrained dirty air is isolated from the clean air which is in direct contact with the imaging device and the lens assemblies. Hence, chamber 30 contains a mixture of compressed clean air and entrained dirty air, whereas chamber 23 and the space within the front inner tube (an hence the inner-most portion of intermediate assembly 23) contains only clean compressed air.

The intermediate subassembly 22 is shown as being a horizontally-elongated specially-configured member having a central axial through-bore which is arranged to accommodate and receive another mating optical member, generally indicated at 33, for receiving the video image received from member 32 and for transmitting it rightwardly to the camera. Compressed fluid supplied to inlet 24 is first supplied to eductor blocks 25, 25. These manifold blocks then transmit fluid via conduits, 34, 34 to the right marginal end portion of chamber 30 at diametrically-spaced locations thereon. The discharged fluid jets by openings, several indicated at 35, which tends to entrain air into the jetted flow, and to pass the flow from right to left through leftward subassembly passageway 30. The supplied air is also provided, via fitting 36, to a line which communicates with air motor 38 mounted in the right subassembly at 23. Compressed fluid exiting this motor is discharged via line 39, and is supplied via conduit 40 to the right marginal end portion of left subassembly chamber 30. Thus, the fluid discharged from the air motor is added to the leftward cooling flow through passageway 30.

As shown in Fig. 6, pneumatic motor 38 is operatively arranged to drive generator 40, which, in turn, provides electrical power to a CCD adapter 41 mounted in the rightward subassembly 23. This CCD adapter is arranged to provide an electrical output signal to terminal 26 in the right end cap. Supplied fluid is also provided to the chamber within right subassembly 23 to positively pressurize this chamber with respect to the atmosphere. The air in chamber 23 is permitted to exhaust, in a controlled manner, via an exhaust restrictor located on rightwardmost surface 49 to facilitate cooling within chamber 23. A portion of the air supplied to the chamber within the front inner tube is permitted to pass rightwardly into rear chamber 23 to hold this chamber at a positive pressure relative to the atmosphere. Allowing this air to change (by controlled exhaust) facilitates a degree of cooling for the components contained therein. The intermediate part 22 is shown as having a vertical flange member, generally indicated at 42, which is provided with a transversely elongated slot 43. Air motor 38 and generator 40 are held in the illustrated relative positions via a pair of axially-spaced blocks 44, 45 respectively. The optical components are secured only within sub-assembly 22 with the forwardmost (i.e., leftwardmost) portion being supported within the nozzle at the forwardmost portion of the front inner tube 27, and this optical device supports the entire weight of the camera. The idea here is that the optical assembly and camera are mostly isolated from any vibration generated by the air motor and generator.

The right subassembly 23 is shown as being contained within a horizontally-elongated

thin-walled outer tubular casing, generally indicated at 46. The left end of this casing is closed by an annular block 48 which is adapted to mate with the right marginal end of intermediate section 22. The right end of subassembly 23 is closed by a rightward cap 49. As best shown in Fig. 9, cap 49 has a first visual display which is operatively arranged to display 50 which is arranged to display the temperature sensed by the camera, and has a second display 51 which is operatively arranged to display the voltage produced by the generator. The apportionment of flow to the air motor vis-a-vis the other flow passages may be controlled from within the apparatus.

Thus, the invention provides an improved fluid-powered inspection device that is adapted to be operated in a heated and/or otherwise contaminated environment. The device has an assembled body which includes a tubular shell 28 terminating in a leftward open end; an imaging device having a portion 32 arranged within the tubular shell and spaced relation thereto so as to define an annular chamber 30 there between, the imaging device having an eye 31 positioned adjacent the leftward open end; a fluid powered motor 38 arranged within the body, this motor having a fluid inlet adapted to be connected to a suitable source of compressed fluid and having a fluid outlet; a generator 40 arranged within the body and operatively coupled to the motor, the generator being arranged to supply electrical power to the imaging device as a function of the fluid flow passing through the motor; and wherein the fluid discharged from the motor also passes through the annular chamber and is discharged through an open end. Thus, the compressed fluid supplied to the motor both powers and provides

a medium for cooling the imaging device and keeping the eye clean.

Modifications

The present invention expressly contemplates that many changes in modifications may be made. For example, while the embodiment shown in the drawings is presently preferred, it is intended to be illustrative of only one embodiment falling within the generic scope of the claims. Thus, for example, the body could be made in three subassemblies, or could be made in a greater or lesser number, as desired. The salient point here is that a portion of the imaging device be arranged to be cooled by the flow of fluid thereabout. This flow of fluid also serves to keep clean the eye at the end thereof, and to blow contaminants away from the space or volume to the left of the eye, so as not to hinder the sight thereof. The supplied fluid may, in most cases, be compressed air. However, fluids other than compressed air might alternatively be provided. Thus, the structure of the body and the imaging device may be readily changed or modified as desired. In this regard, it is contemplated that the imaging device may be a video camera, an infrared camera, or some other type of device, such as a pyrometer or the like. These are only a few examples of things that are intended to fall within the broad generic description of "imaging device".

Therefore, while the presently preferred form of the improved fluid-powered inspection device has been shown and described, and several modifications thereof

discussed, persons skilled in this art will readily appreciate the various additional changes and modifications may be made without departing from scope of the invention, as defined by the following claims.

CLAIMS

1. A fluid-powered inspection device adapted to be operated in a contaminated environment, comprising a body having a tubular shell terminating in an open end, an imaging device having a portion arranged within said tubular shell in spaced relation thereto so as to define an annular chamber therebetween, said imaging device having an eye positioned adjacent said open end, a fluid-powered motor arranged within said body, said motor having a fluid inlet adapted to be connected to a suitable source of compressed fluid and having a fluid outlet, a generator arranged within said body and operatively coupled to said motor, said generator being arranged to supply electrical power to said imaging device as a function of the fluid flow passing through said motor, and wherein the fluid discharged from said motor outlet passes through said annular chamber and is discharged through said open end, whereby the fluid supplied to said motor powers and cools said imaging device and keeps clean said eye.

2. A fluid-powered inspection device according to claim 1 wherein said fluid is air.

3. A fluid-powered inspection device according to claim 1 wherein said imaging device is a video camera.

4. A fluid-powered inspection device according to claim 3 wherein said camera

is a television camera.

5. A fluid-powered inspection device according to claim 3 wherein said camera is an infrared camera.

6. A fluid-powered inspection device according to claim 1 wherein said eye includes a lens.

7. A fluid-powered inspection device according to claim 1 wherein the flow of fluid discharged from said tube open end is directed to protect said eye from contaminants in said environment.

8. A fluid-powered inspection device according to claim 1 and further comprising an eductor, wherein the fluid discharged from said motor outlet passes through said eductor and entrains air from within said chamber into the flow discharged through said open end.

9. A fluid-powered inspection device according to claim 8 wherein compressed fluid supplied from said source is combined with fluid discharged from said motor outlet upstream of said eductor.

10. A fluid-powered inspection device according to claim 1 wherein said fluid is

arranged to cool said imaging device.

11. A fluid-powered inspection device substantially as herein described with reference to the accompanying drawings.

ABSTRACT

FLUID-POWERED INSPECTION CAMERA

A fluid-powered inspection device (20) adapted to be operated in a contaminated environment includes a body (21, 22, 23) having a tubular shell (28) terminating at an open end. An imaging device has a portion (32) arranged within the tubular shell in spaced relation thereto so as to define an annular chamber (30) therebetween. The device has an eye (31) positioned adjacent the open end. A fluid-powered motor (38) is arranged within the body. This motor has a fluid inlet adapted to be connected to a suitable source of compressed fluid and has a fluid outlet. A generator (40) is arranged within the body and is operatively coupled to the motor. The generator is arranged to supply electrical power to the imaging device as a function of the fluid flow through the motor. Fluid discharged from the outlet passes through the annular chamber and is discharged through the open end. Hence, compressed fluid supplied to the motor powers and cools the imaging device, and keeps clean the eye.

Fig. 6.

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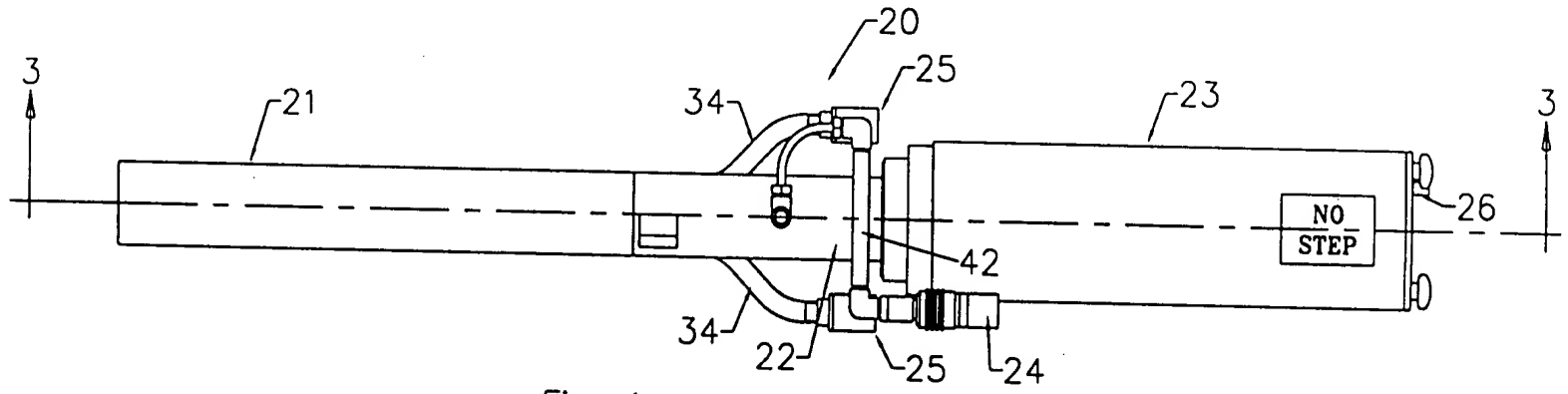
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Fig. 1

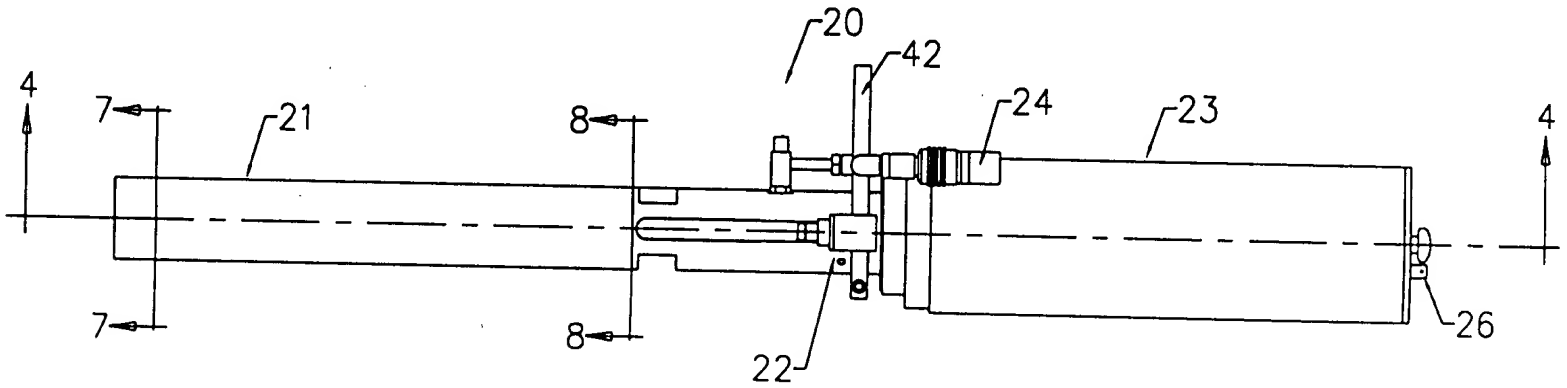
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Fig. 2

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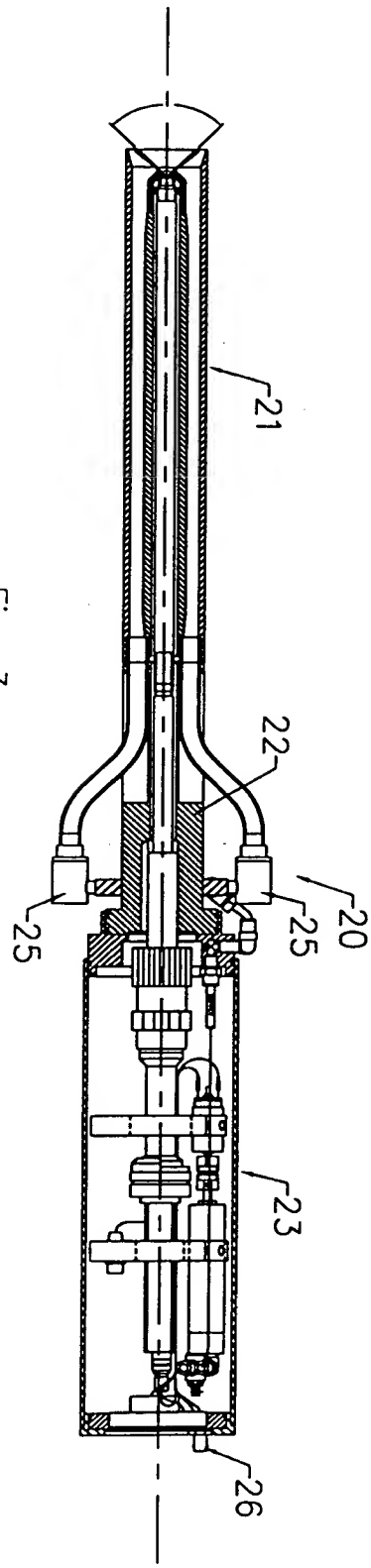

Fig. 3

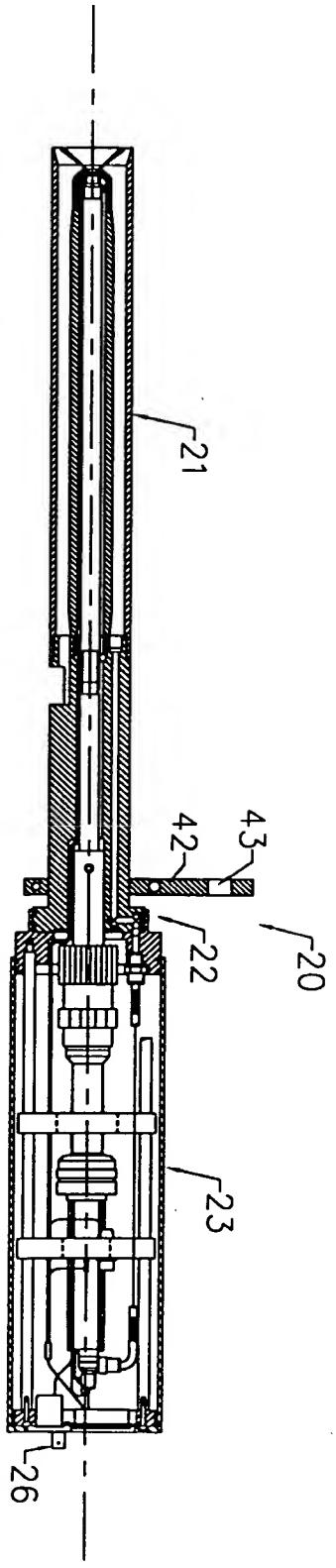

Fig. 4

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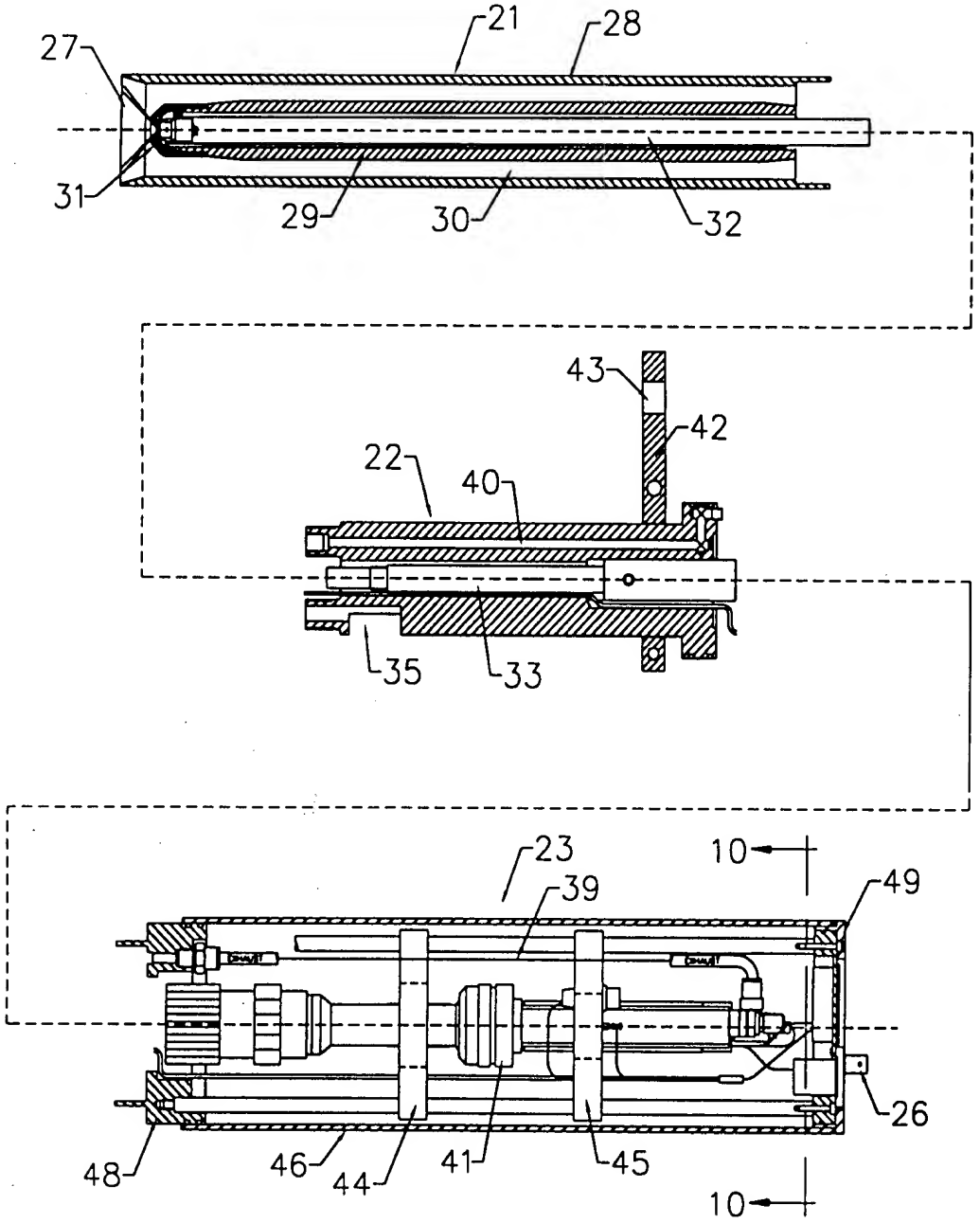

Fig. 5

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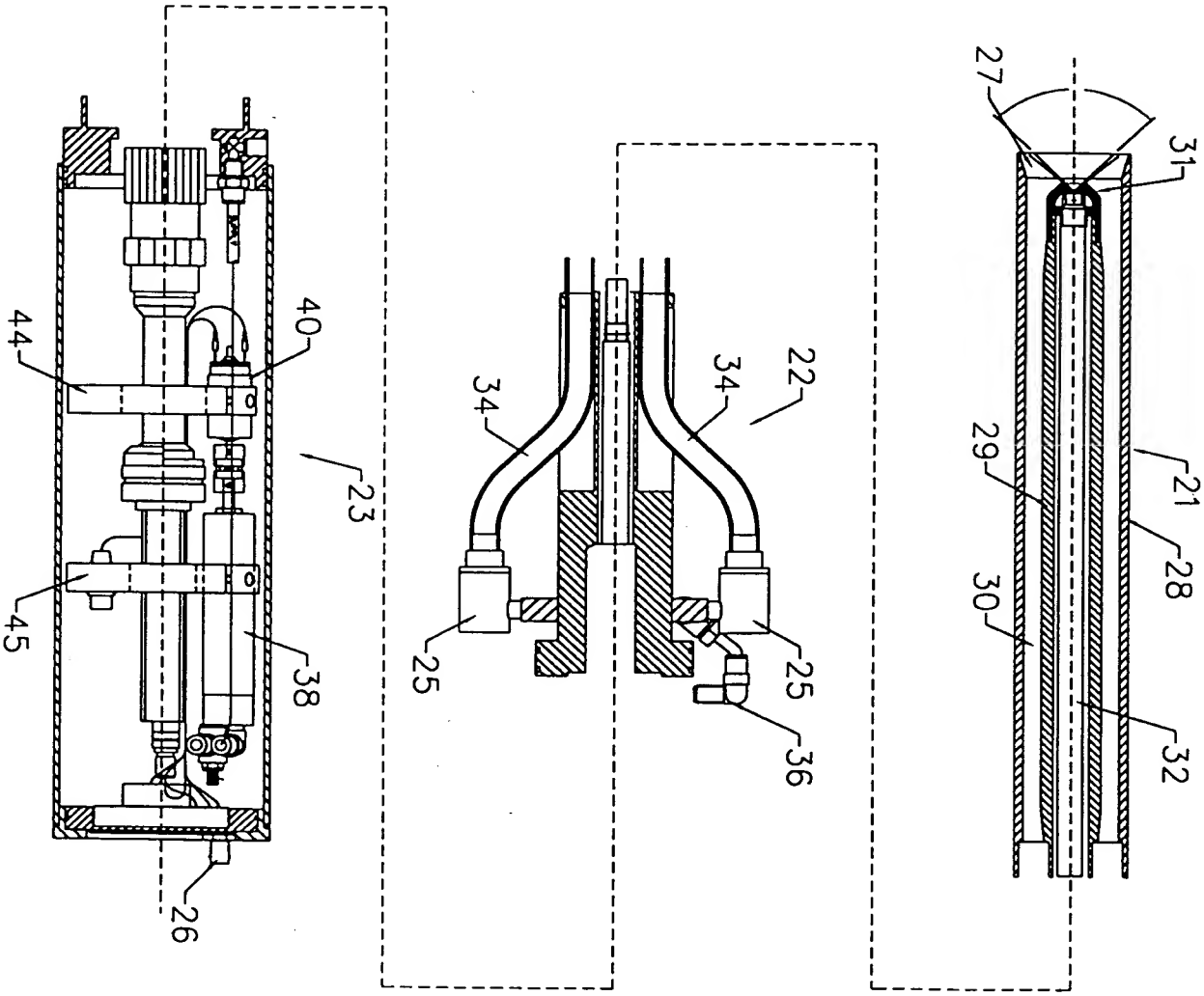

Fig. 6

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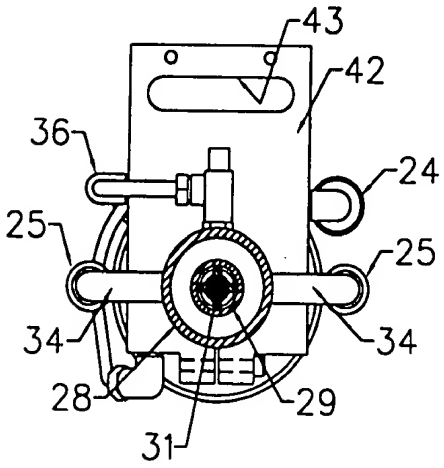

Fig. 7

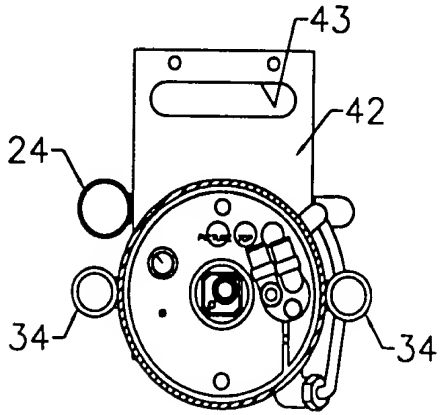

Fig. 10

5/5

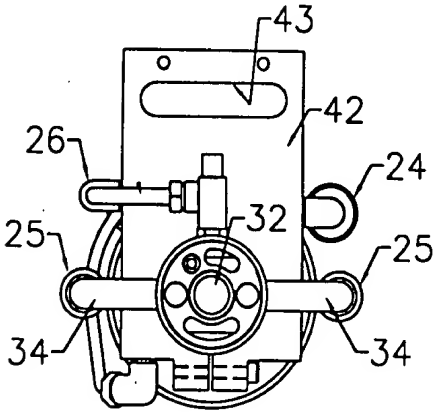

Fig. 8

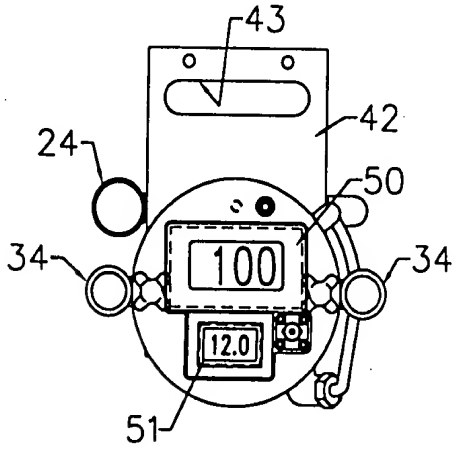

Fig. 9

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